



Complete Summary

GUIDELINE TITLE

ACR Appropriateness Criteria™ for stress/insufficiency fractures (excluding vertebral).

BIBLIOGRAPHIC SOURCE(S)

Manaster BJ, Dalinka MK, Alazraki N, Berquist TH, Daffner RH, DeSmet AA, el-Khoury GY, Goergen TG, Keats TE, Newberg A, Pavlov H, Haralson RH, McCabe JB, Sartoris D. Stress/insufficiency fractures (excluding vertebral). American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun; 215(Suppl): 265-72. [29 references]

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INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT

CATEGORIES

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SCOPE

DISEASE/CONDITION(S)

Stress/insufficiency fractures (excluding vertebral)

GUIDELINE CATEGORY

Diagnosis

CLINICAL SPECIALTY

Emergency Medicine

Family Practice

Orthopedic Surgery

Radiology

Sports Medicine

INTENDED USERS

Health Plans
Hospitals
Managed Care Organizations
Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of initial radiologic examinations for stress/insufficiency fractures (excluding vertebral).

TARGET POPULATION

Patients with stress/insufficiency fractures (excluding vertebral)

INTERVENTIONS AND PRACTICES CONSIDERED

1. Plain x-ray
2. Computed tomography
3. Magnetic resonance imaging
4. Bone scan, 3-phase
5. Tomography

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of recent peer-reviewed medical journals, primarily using the National Library of Medicine's MEDLINE database. The developer identified and collected the major applicable articles.

NUMBER OF SOURCE DOCUMENTS

The total number of source documents identified as the result of the literature search is not known.

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Expert Consensus (Delphi Method)
Weighting According to a Rating Scheme (Scheme Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not applicable

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed to reach agreement in the formulation of the Appropriateness Criteria. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1-9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty (80) percent agreement is considered a consensus. If consensus cannot be reached by this method, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria and the Chair of the ACR Board of Chancellors.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria™

Clinical Condition: Stress/Insufficiency Fracture (excluding vertebral)

Variant 1: Suspect stress/insufficiency fracture. First imaging modality.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Plain x-ray	9	Plain film is a required first step before consideration of other imaging.
Computed tomography	1	
Magnetic resonance	1	
Bone scan, 3-phase	1	
Tomography	1	
<u>Appropriateness Criteria Scale</u>		
1 2 3 4 5 6 7 8 9		
1=Least appropriate 9=Most appropriate		

Variant 2: Suspect stress fracture in otherwise normal patient; patient referred with plain film normal. Need for immediate diagnosis is not urgent, not hip or sacrum.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Repeat plain x-ray in 14 days	9	Many patients will recover in the interim and not return; cost of waiting for confirmation is usually low.

Magnetic resonance imaging	6	In the clinical situation stated above, many clinicians would wait until repeat plain film was negative before going to magnetic resonance; with an anxious patient or clinician, or repeated negative plain film, magnetic resonance is the favored next imaging modality; if the diagnosis can be made with a single T1 sequence in the appropriate plane of imaging, the exam can be stopped and charges decreased accordingly.
Bone scan, 3-phase	3	If the patient or clinician is too anxious to wait for repeat plain x-ray, could do magnetic resonance <u>or</u> bone scan (but not both); panel prefers magnetic resonance since it is usually more specific than bone scan.
Computed tomography	1	Not indicated.
Tomography	1	Tomography is not universally available and is too technologist dependent.
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1=Least appropriate 9=Most appropriate</p>		

Clinical Condition: Stress/Insufficiency Fracture (excluding vertebral)

Variant 3: Suspect fracture in patient with urgent need to know
diagnosis: not hip or sacrum; patient referred with plain film normal.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging	7	Magnetic resonance imaging is more specific than bone scan; therefore it is preferred.
Bone scan, 3-phase	6	Bone scan or magnetic resonance imaging indicated (not both). Magnetic resonance imaging preferred by panel.
Repeat plain x-ray in 10 to 14 days	1	Premise of urgent need to know.
Computed tomography	1	

Tomography	1	
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1 =Least appropriate 9=Most appropriate</p>		

Variant 4: Suspect stress fracture; patient referred with plain film normal but bone scan positive and nonspecific, not hip or sacrum.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Repeat plain x-ray in 10 to 14 days	7	For confirmation or question of complication.
Magnetic resonance imaging	3	Generally not necessary.
Computed tomography	1	
Tomography	1	
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1 =Least appropriate 9=Most appropriate</p>		

Clinical Condition: Stress/Insufficiency Fracture (excluding vertebral)

Variant 5: Suspect stress fracture in otherwise normal patient; patient referred with plain film and bone scan or magnetic resonance imaging normal.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging	2	Not indicated if plain x-ray and magnetic resonance imaging were normal; but if the studies were plain film and bone scan that were normal and there is persistent pain, the clinician might re-examine the diagnosis and consider magnetic resonance imaging, looking for soft tissue injury.
Repeat plain x-ray in 10 to 14 days	1	Not necessary. No further imaging is warranted.

Computed tomography	1	
Repeat bone scan, 3-phase	1	
Tomography	1	
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1=Least appropriate 9=Most appropriate</p>		

Variant 6: Clinical differential fracture versus metastasis in long bone; patient referred with plain film normal, bone scan hot but nonspecific.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging	9	
Repeat plain x-ray in 10-14 days.	1	Too anxiety producing. An occult metastasis is unlikely to appear on plain film in this period.
Computed tomography	1	
Tomography	1	
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1=Least appropriate 9=Most appropriate</p>		

Variant 7: Clinical differential insufficiency fracture versus metastasis in sacrum; patient referred with plain film normal, bone scan hot but nonspecific.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Computed tomography	9	Axial cuts only.
Repeat plain x-ray in 10 to 14 days	1	

Magnetic resonance imaging	1	Magnetic resonance imaging is confusing in the sacrum in these circumstances, often leading to an incorrect diagnosis of tumor.
Tomography	1	
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1=Least appropriate 9=Most appropriate</p>		

Clinical Condition: Stress/Insufficiency Fracture (excluding vertebral)

Variant 8: Elderly patient with suspect insufficiency fracture in sacrum/pelvis; patient referred with plain film normal; bone scan hot in linear pattern typical for fracture.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Computed tomography	2	As long as it is unequivocal on bone scan, computed tomography not needed; otherwise, go to axial computed tomography.
Repeat x-ray in 10 to 14 days	1	
Magnetic resonance imaging	1	
Tomography	1	
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1=Least appropriate 9=Most appropriate</p>		

Variant 9: Suspect insufficiency fracture in osteoporotic patient (or patient on long-term steroid therapy), not hip; patient referred with plain film normal.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Repeat plain x-ray in 10 to 14 days or bone scan, 3-	9	Panel agrees one of these three exams should be done. The clinical condition and location will dictate which. If the diagnosis

phase, or magnetic resonance imaging		is not urgent, repeat plain x-ray may be all that is necessary. If there is greater urgency, the panel favors magnetic resonance imaging over bone scan because bone scans can be falsely negative in this patient population.
Computed tomography	1	
Tomography	1	
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1=Least appropriate 9=Most appropriate</p>		

Variant 10: Suspect insufficiency fracture (not hip) in osteoporotic patient or patient on long-term steroid therapy; patient referred with plain x-ray and bone scan (3-phase) normal at 48 hours.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Repeat plain x-ray in 10 to 14 days or magnetic resonance imaging	9	If diagnosis is nonurgent, repeat plain x-rays; otherwise go to magnetic resonance imaging. Bone scan may be falsely negative in this patient population.
Computed tomography	1	
Tomography	1	
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1=Least appropriate 9=Most appropriate</p>		

Clinical Condition: Stress/Insufficiency Fractures (excluding vertebral)

Variant 11: Suspect subacute insufficiency fracture of hip in osteoporotic patient (or patient on steroid therapy); patient referred with plain x-rays normal; what is the most effective method of diagnosis?

Radiologic Exam Procedure	Appropriateness Rating	Comments
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Magnetic resonance imaging	9	A limited magnetic resonance imaging exam may yield the diagnosis, may need to proceed to full magnetic resonance imaging (no intravenous contrast needed).
Bone scan, 3-phase	1	Indicated if magnetic resonance cannot be performed.
Repeat plain x-ray in 10 to 14 days	1	
Computed tomography	1	
Tomography	1	
<p style="text-align: center;"><u>Appropriateness Criteria Scale</u></p> <p style="text-align: center;">1 2 3 4 5 6 7 8 9</p> <p style="text-align: center;">1=Least appropriate 9=Most appropriate</p>		

Summary

Although many stress/insufficiency fractures are self-limited because they heal with or without diagnosis, there is usually value to making the diagnosis. With continued activity, some stress fractures will progress to completion and require more invasive treatment. Also the differential diagnosis of stress/insufficiency fractures includes entities that would be treated significantly differently than stress fractures (osteoid osteoma or osteomyelitis in the younger patient, metastases in the older).

The clinical setting is often highly suggestive of the diagnosis (repetitive or new athletic activity for stress fractures, osteoporosis, or radiated bone for insufficiency fractures) and specific athletic activities often result in specific sites of stress fractures. Insufficiency fractures also occur at fairly predictable sites. Thus, plain film diagnosis using such pattern and site recognition is usually quite specific. Late plain film findings may be quite typical in appearance as well: linear sclerosis, often perpendicular to the major trabecular lines. However, early plain film findings are less specific (subtle periosteal reaction) or even nonexistent. Plain film in stress/insufficiency fractures may be negative initially in 60%-82% and remain negative in 46%-60%, depending on different specifications of bone scan gold standards. Thus, plain film is specific but significantly insensitive. All references agree that plain film should be the initial imaging modality; if the findings are conclusive, no further imaging need be performed.

Bone scans have long been accepted as extremely sensitive for detecting stress/insufficiency fractures especially if single photon emission computed tomography is used. The objection to the studies is that, in each, a positive bone scan is taken as the gold standard for stress fractures and therefore sensitivity is 100%. However, depending on the staging criteria for bone scan pattern, the abnormalities may in fact be stress reactions rather than actual stress fractures.

Nonetheless, it is clear that bone scans show stress fractures days to weeks earlier than plain films in many instances, and differentiate between osseous and soft tissue injury as well. In some cases, the pattern of fracture is such that the diagnosis is secure, and no further imaging is required (for example, the H sign of sacral insufficiency fractures). However, in most cases bone scans lack specificity (with synovitis, arthritis, degenerative joint disease, stress reactions, and tumor appearing similar) and supplemental imaging may be necessary for conclusive diagnosis or to avoid false positives.

Because of the sensitivity of bone scan, 80% of all fractures show bone scan abnormality 24 hours post injury and 95% at 72 hours. A normal bone scan generally excludes the diagnosis of stress/insufficiency fracture, and the patient may return to normal activity. However, there are exceptions. Elderly or osteoporotic patients may have a delay in bone scan activity that may last several days. Patients using steroids may also have less sensitive bone scan results.

Other imaging should be regarded as ancillary, to be used in answering a specific question or confirming a diagnosis, but not routinely. Routine tomography has been used effectively in the past to confirm stress fractures. It is, however, highly technologist dependent and has been shown to have false negatives. It has been superseded by computed tomography with reformatting. Axial computed tomography alone may have false negatives due to the constraint of the axial plane [in one study, only 1/2 of the stress fractures were adequately demonstrated on computed tomography]. Therefore, if computed tomography is used to confirm stress fracture in a long bone, reformatting is usually necessary. Longitudinal stress fractures of the tibia have been emphasized in the literature recently. Up to 25% may appear normal on plain films, but computed tomography or magnetic resonance findings are characteristic. Magnetic resonance is very sensitive to the bone marrow edema accompanying these longitudinal fractures, and may give a misleadingly aggressive appearance. The one setting in which axial computed tomography alone is extremely useful is in differentiating insufficiency fractures from metastases in elderly or radiated patients with nonspecific sacral and pelvic bone scan uptake. Magnetic resonance may either show the sacral stress fracture, or may give a more aggressive appearance if only the associated edema is seen. Magnetic resonance may, however, also demonstrate other reasons for occult pelvic pain, such as soft tissue abnormality or the supra-acetabular stress fractures recently described in these osteoporotic patients.

Magnetic resonance should be considered an ancillary rather than an obligatory study for most stress/insufficiency fractures. Magnetic resonance is extremely sensitive and appears to demonstrate abnormalities as early as and with as much sensitivity as bone scan. The critical time for magnetic resonance becoming positive has not yet been established, although it seems that the edema pattern would be present within hours of the injury. Some studies demonstrate the magnetic resonance pattern to be nonspecific and even confusing when only edema and not the fracture line is demonstrated. This problem seems particularly severe in differentiating sacral or pelvic insufficiency fractures from metastases. Over reliance on nonspecific low-signal T1 and high-signal T2 magnetic resonance patterns leads to misdiagnosis of stress fractures as more aggressive lesions. On the other hand, magnetic resonance of long bones often shows the fracture line itself; in this case, magnetic resonance becomes not only sensitive but quite

specific [fracture line seen in 11/14 stress fractures, 7/9 hip fractures and 13/13 true positive hip fractures. The site where this phenomenon has been evaluated most completely is the hip, which may yield false negatives early on both plain film and bone scan of the osteoporotic patient. A single T1 coronal magnetic resonance sequence yields 100% accuracy in studies of 23 and 20 hips; this highly sensitive and specific single sequence should cost less than bone scan. Many experts recommend that a single T1 magnetic resonance sequence in the plane of interest be performed and initially evaluated when stress fracture is suspected. If a fracture is clearly seen, the examination may be terminated and charged as a limited exam. If the question persists after the single sequence, other magnetic resonance sequences may be used for more complete examination (e.g., STIR sequences for even more sensitive evaluation of marrow edema, or T2 sequences for evaluation of nearby soft tissue injury). Intravenous contrast should not be required.

CLINICAL ALGORITHM(S)

Algorithms were not developed from criteria guidelines.

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Appropriate selection of radiologic exam procedures to evaluate possible stress/insufficiency fractures.

POTENTIAL HARMS

None identified

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical

consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Manaster BJ, Dalinka MK, Alazraki N, Berquist TH, Daffner RH, DeSmet AA, el-Khoury GY, Goergen TG, Keats TE, Newberg A, Pavlov H, Haralson RH, McCabe JB, Sartoris D. Stress/insufficiency fractures (excluding vertebral). American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun; 215(Suppl):265-72. [29 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1995 (revised 1999)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria™.

GUIDELINE COMMITTEE

ACR Appropriateness Criteria™ Committee, Expert Panel on Musculoskeletal Imaging.

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Names of Panel Members: B.J. Manaster, MD, PhD; Murray K. Dalinka, MD; Naomi Alazraki, MD; Thomas H. Berquist, MD; Richard H. Daffner, MD; Arthur A. DeSmet, MD; George Y. El-Khoury, MD; Thomas G. Goergen, MD; Theodore E. Keats, MD; Arthur Newberg, MD; Helene Pavlov, MD; Robert H. Haralson, III, MD; John B. McCabe, MD; David Sartoris, MD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline. It is a revision of a previously issued version (Appropriateness criteria for stress/insufficiency fractures (excluding vertebral). Reston [VA]: American College of Radiology (ACR); 1995. 8 p. [ACR Appropriateness Criteria™]).

The ACR Appropriateness Criteria™ are reviewed after five years, if not sooner, depending upon introduction of new and highly significant scientific evidence. The next review date for this topic is 2004.

GUIDELINE AVAILABILITY

Electronic copies: Available from the [American College of Radiology \(ACR\) Web site](#).

Print copies: Available from ACR, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

AVAILABILITY OF COMPANION DOCUMENTS

None available

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on May 6, 2001. The information was verified by the guideline developer as of June 29, 2001.

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The logo for FIRSTGOV, with "FIRST" in blue and "GOV" in red, and a small American flag graphic above the "I".

